

TEST DATA ON THE STORAGE OF MIXED MUNITIONS IN CONEX CONTAINERS

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ABSTRACT

A series of 10 tests was conducted to identify debris, fragments, and airblast hazards associated with the detonation of the explosives in Conex containers. Eight of these tests were conducted at Socorro, NM, and the last two tests were conducted at China Lake, CA. The first three and last two tests were conducted without any kind of confinement around the Conex containers. The fourth, fifth, and sixth tests were conducted by sandbagging the Conex containers on three sides. In tests 7 and 8, the containers were sandbagged on three sides, and a 12-foot sandbag wall (20-foot wall in test 8) wall was erected at a distance of 15 feet from the front side of the container.

A lot of fragments were found beyond 300 feet in Tests 1, 2, 3, 6, 9, and 10. Only a few fragments were found beyond 300 feet in Tests 4, 5, 7, and 8. Some fragments were found beyond 600 feet in Tests 6, 9, and 10. A few metal fragments of Conex container were also found between 900 and 1,155 feet in Tests 9 and 10.

The fragment density at any distance was computed on the basis of a worst-case assumption. It was assumed that any fragment found in a sector at a distance greater than x feet from the origin could hit a standing person in that sector. The fragment density was computed as the number of fragments divided by the vertical area and multiplied by 600. That gave the fragment density per 600 square feet.

The fragment density, at different locations, is calculated by using 30-degree sectors. When the mean fragment density was computed, the sectors in which no fragments were found were excluded. The fragment density and distance were plotted for 25, 75, 160, and 500 lbs of explosive. For 500 lbs of explosive, the fragment density of less than one fragment per 600 square feet is at about 800 feet. For 160 lbs of explosive (sandbagged test), the fragment density of less than one fragment per 600 square feet is at about 600 feet. On the other hand, the fragment density of less than one fragment per 600 foot, for 75 lbs of explosive, is between 700 to 800 feet.

Comparison of sandbagged and unsandbagged test data clearly shows that sandbagging the containers does decrease the fragment density at larger distances. It also suggests that more tests may be needed, for explosive weights between 75 and 500 lbs and for explosive weights more than 500 lbs. The test data approximately supports the existing explosive weight and distance curve.

INTRODUCTION

A large quantity of different types of munitions are stored in a Conex container. Small caliber ammunition, fragmentation grenades, smoke grenades, signal flares, M42 submunitions, mines, file destroyer, and rockets are stored in the containers. Table I shows a typical basic load of ammunition stored in a container. The study had three objectives. The first objective was to determine the type of debris and fragment hazard distance from point of reaction when the munitions in a single Conex container are detonated. The second objective was to prevent propagation of reaction from one

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TABLE I

A Typical Basic Load of Ammunition Stored in a Conex Container

CTG Cal .45 Ball	1360 Rds
CTG .50 Cal	1800 Rds
CTG 5.5mm Ball M16	23600 Rds
CTG 5.56mm Tracer M16	4930 Rds
CTG 7.62mm Ball & Tracer Lined	9370 Rds
CTG 40mm M433	144 Rds
Grenade Fragmentation M67	195 EA
Grenade Smoke Green	8 EA
Grenade Incendiary	130 EA
Grenade Smoke Red	8 EA
Grenade Smoke HC	8 EA
Grenade Smoke Violet	10 EA
Grenade Smoke Yellow	8 EA
Fire Starter	8 EA
Grenade Launcher Smoke Screening	8 EA
Signal Illum Grenade	36 EA
RKT 66mm M72A2	15 EA
Mines M18A1	12 EA
File Destroyer M4	1 EA
Signal Illum Ground Red Star	72 EA
Illum Star Ground White	72 EA
Signal Illum Ground Green Star	72 EA

container to an adjacent container, and the third objective was to minimize the physical damage to the adjacent Conex by the addition of sandbag walls along the three sides of containers.

The project was funded and supported by the Department of Defense Explosives Safety Board and the Project Manager for Ammunition logistics. The task of designing and conducting the tests and providing the technical data package was undertaken by the Ballistic Research Laboratory, Aberdeen Proving Ground, MD.

TESTING AND RESULTS

A series of 10 tests was performed to identify debris, fragments, and airblast hazards associated with the detonation of the explosives (inside a container) and to check whether the mass detonation of explosives in one container would propagate to the adjacent container. A detailed description of the first six tests are given in reference (3). Only a brief summary of the first six tests will be given here. The tests 7 through 10 will be described in more detail.

TEST NO 1

The goal of this test was to identify the external debris, fragments, and to determine the quantity-distance arcs when the explosive (in the Conex container) was detonated. Table II lists the ammunition placed inside the container. The mines were detonated inside the container. The fragments and other debris were located within 100 feet from the point of detonation. Some of the fragments were found beyond 350 feet from the test location. Three metal fragments from the Conex were located between 320 feet and 375 feet from the point of reaction. Five fragmentation grenades were located at 375 feet. Figure 1 shows the after-test photographs.

TEST NO 2

The goal of this test was to assess the damage to the acceptor container and its contents when the explosive, in the donor Conex, is detonated. The acceptor container was placed at a distance of 15 feet (arbitrarily chosen) from the donor container. The same amount and type of munitions as in Test 1 was placed in the donor. The wooden ammunition boxes and other debris burned for more than one hour near the acceptor container. The acceptor container was turned over and sustained some physical damage. The donor container was broken up into many fragments. Many of these fragments were thrown to a distance greater than 300 feet. Some fragments and other rounds were found beyond 375 feet from the test location, but most of the fragments were located within a radius of 100 feet. After-test photographs are shown in Figure 2.

TEST NO 3

The goal of this test was to assess the damage to the live munitions, inside the acceptor Conex, by decreasing the separation distance (distance between the containers) from 15 feet to 8 feet. The wooden boxes and other fragments burned in the space between the two containers for one to two hours. Some of the signal flares and grenades were cooked off because of the fire. The acceptor container was flipped over and caved in. The munitions inside the acceptor Conex did not detonate. Some of the munition boxes were broken, but no damage was done to the munitions inside the acceptor container. The fragments and other debris were thrown out at a distance greater than 300 feet

TABLE II

Ammunition in a Conex Container

CTG, Cal .45 Ball and .50 Cal	3160 Rds
CTG, 5.56mm Ball/Tracer M16	28530 Rds
CTG, 7.62mm Ball & Tracer Lined	9370 Rds
Grenade, Fragmentation M67	195 EA
Grenade, Smoke	175 EA
RKT, 66mm M72A2 (unfuzed)	15 EA
Mines, M18A1	12 EA
File Destroyer, M4	1 EA
Signal, Illum Ground	260 EA
Rifle Grenade, M42	216 EA

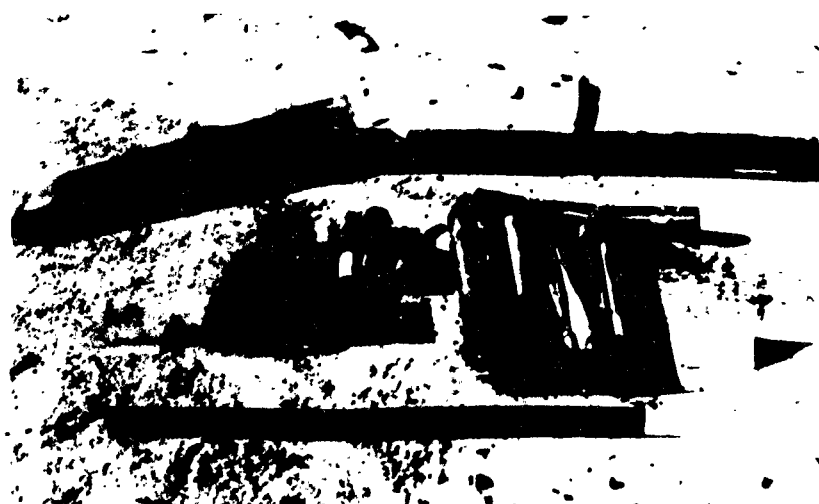
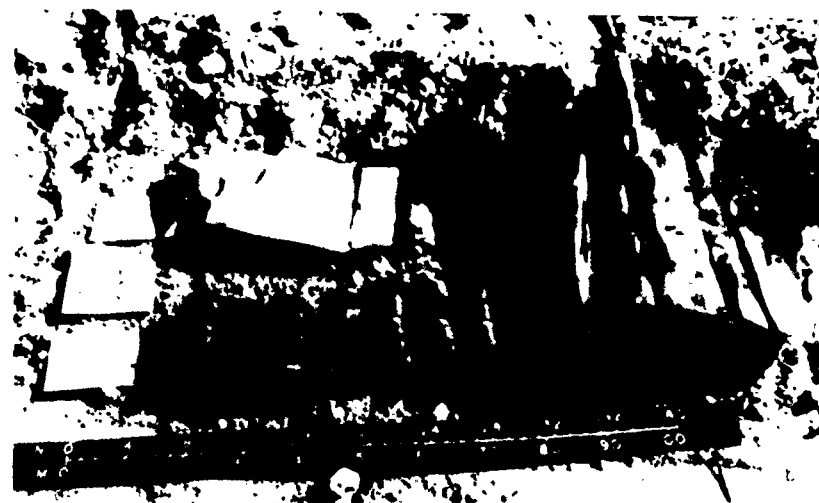


Figure 1. Test No. 1. (a) File Dest, Conex part, and Smoke grnd; (b) Conex part and Smoke Grnd; (c) Frag Grnd; and (d) Smoke grnd, M42 grenades (grnd), and 66mm Rockets (Rkt).

from the point of reaction. Ten metal fragments were found between 300 feet and 335 feet from the test location. Thirty-five M42, two smoke grenades, and one fragmentation grenade were found between 300 feet and 350 feet. Figure 3 shows after-test photographs.

TEST NO 4

The aim of this test was to check whether some kind of sandbag wall/shield will prevent the acceptor container from overturning and sustaining physical damage. The sandbag walls, about one foot taller than the height of the container, were built along three sides of the containers. The wooden boxes and other debris burned for more than two hours. Some munitions (grenades, flares, etc.) were cooked off. The middle sandbag wall was partially collapsed. The acceptor Conex did not move or flip over and no damage was done to munitions inside the acceptor Conex. Much of the blast was absorbed by the sandbag wall, thus preventing the acceptor Conex from sustaining much damage. The donor container and other munition boxes were broken into many fragments. Two fragments (3 x 6 feet) from the door of the Conex container were located at 369 and 561 feet from the test location. One fragment from the Conex was found at 450 feet. One 66-mm rocket (warhead) was found at 305 feet. After-test results are shown in Figure 4.

TEST NO 5

The aim of this test was to learn about the extent of the fragments/debris hazards by detonating the same amount of the explosives in the donor Conex when sandbags were placed on top of the donor container. The same type of sandbag walls were built along three sides of the containers as in Test 4. The door of the donor Conex was found between 50 and 60 feet from the container. The roof of the donor container flew up but fell right back in the container. The debris and fragments did not go very far from the point of detonation. A few parts of the signal flares were located beyond 300 feet from the test location. Most of the munitions and other fragments burned inside the donor container and continued burning for more than three hours. The sandbag wall between the acceptor and the donor containers was partially collapsed. The walls of the acceptor container suffered some damage, but the container itself remained intact. The acceptor container did not flip or turn over.

TEST NO 6

Double sandbag walls, along the three sides of the containers, were built for this test. Munition placement, inside the donor Conex, was changed without changing the total amount of explosive. This time, 60 lbs of explosive (rockets, M42, and fragmentation grenades) were placed close to 100 lbs of C-4 bare charge. The 160 lbs of explosive was placed against the inside wall of the donor Conex (the wall close to the acceptor Conex) and on the lower shelf of the wooden rack. The 100 lbs of explosive was detonated. A big fire ball was seen, and a tremendous explosion was heard. A few flares and grenades burned for a few minutes. No other fire was observed in this test. No explosive (rockets, mines, etc.) was recovered. This means that all 160 lbs of explosive was consumed during the explosion process. The detonation did not propagate to the live munitions, inside the acceptor Conex. One side (the side towards the donor Conex) of the acceptor Conex was caved in, but it did not flip over. The donor container and some of the munition boxes were broken into many fragments. These fragments were found at different locations. Twenty-six metal fragments (8 inches to 5 feet long) were found at a distance between 440 feet and 673 feet from ground zero. After-test pictures are shown in Figure 5.

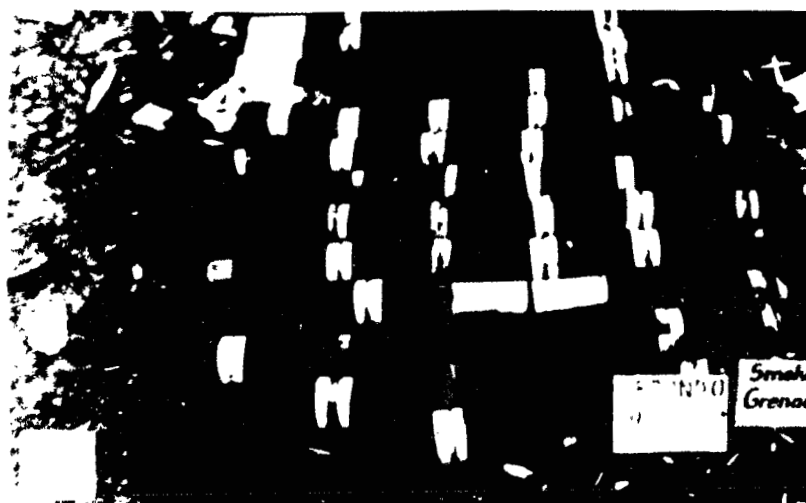


Figure 2. Test No. 2. (a) Acceptor Conex; (b) 7.62mm, 50 Cal, and Frag grnd; (c) Smoke grnd; and (d) 66mm Rocket.

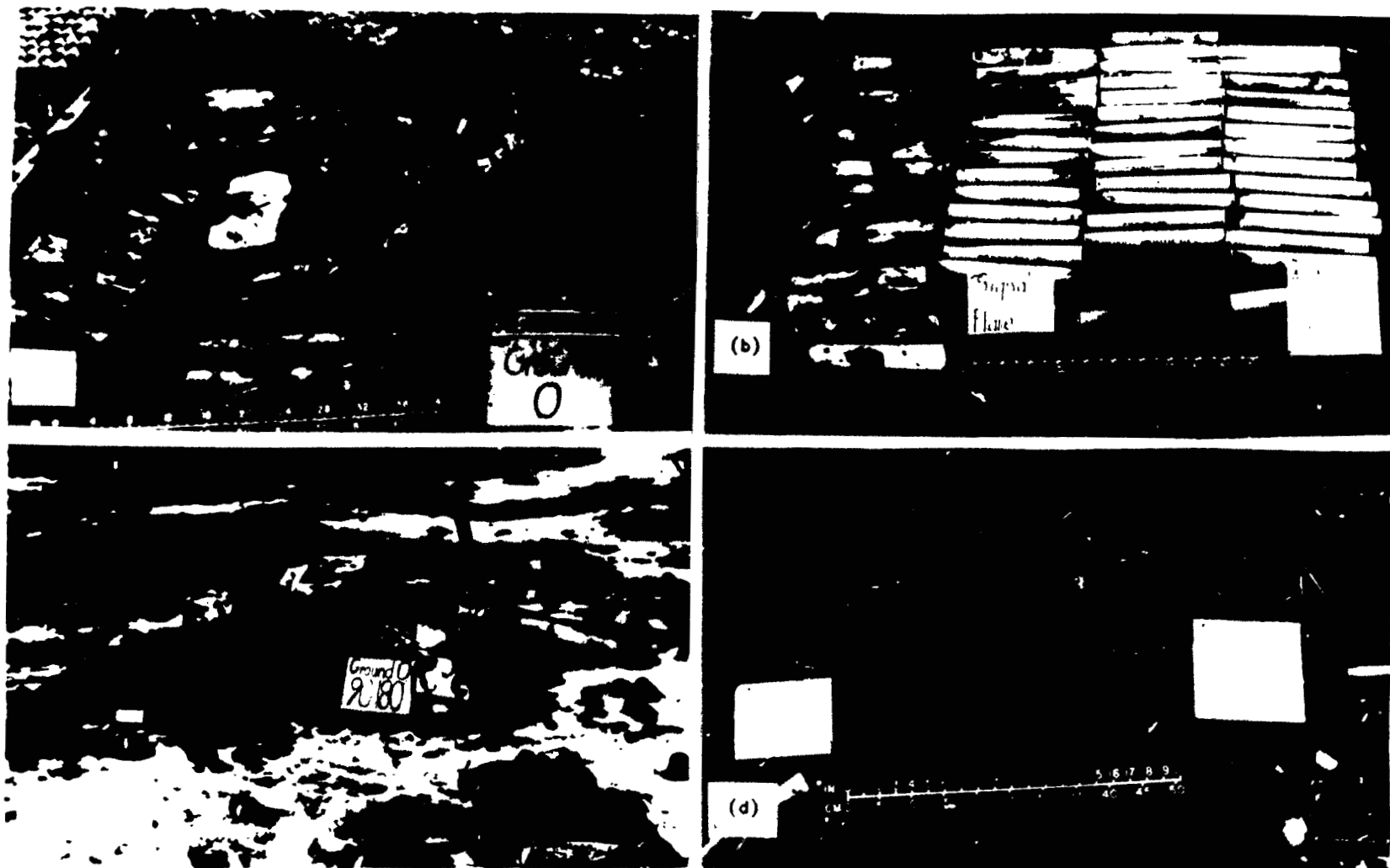


Figure 3. Test No. 3. (a) Part of Donor Conex; (b) Signal flares; (c) Mixed munitions; and (d) M42 grnd.

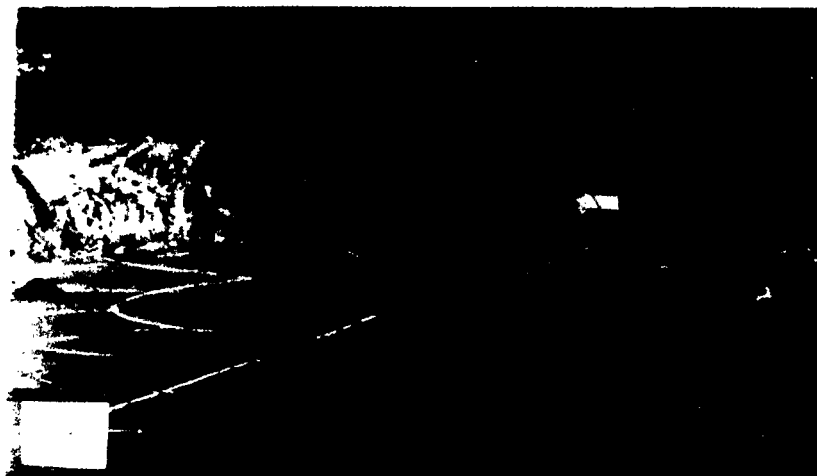


Figure 4.1. Test No. 4. (a) Overall View after the Test; (b) Acceptor Conex; and (c) Bottom part of Donor Conex.

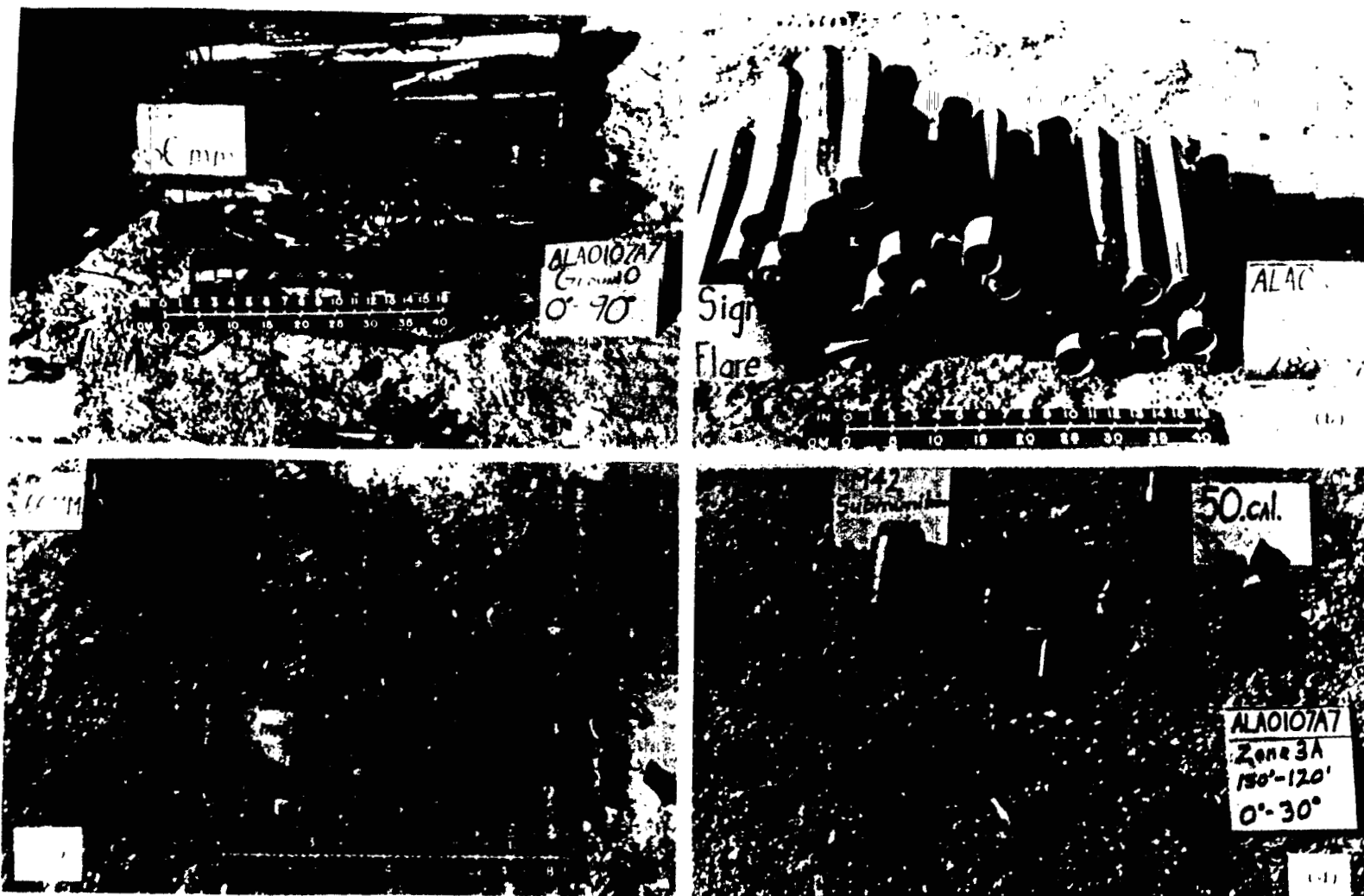


Figure 4.2. Test no. 4. (a) 66mm Rockets; (b) Flares; (c) Rocket parts, 50 Cal, and 7.62mm; and (d) 50 Cal and M42 grnd



Figure 5. Test No. 6. (a) 5.56mm, 50 Cal, and 7.62mm; (b) Conex part; (c) Ammo Box; and (d) Smoke grd.

TEST NO 7

No sandbag wall was built in front of the Conex in any of the tests conducted previously. In this test, a 12-foot-long and 7-foot-high sandbag wall was built at a distance of 15 feet from the front wall of the Conex container. The sandbag walls were also built around three sides of the container. Two layers of sandbags were also placed on top of the container. The same type and amount of munitions as in Test 2 was placed in the donor container. Three pressure transducers were placed at a distance of 30 feet, 60 feet, and 75 feet from the front door of the container. Twelve mines were placed at the center of the container. The stacking details of the munitions inside the container are shown in Figure 6, and the sandbag wall configuration is shown in Figure 7.

The mines were remotely detonated. About 70% of the fragments were located within a 60-foot radius. A very few fragments were also found beyond 300 feet from the container. A few grenades and flares cooked off. The wooden boxes and other debris burned for many hours. The pressures of 3.8 psi at 30 feet, 2.2 psi at 60 feet, and 1.0 psi at 75 feet were registered by the pressure transducers. Figure 8 shows after-test photographs.

TEST NO 8

This test was conducted to check whether increasing the length of the front sandbag wall would have any effect in reducing the number of fragments. So, a 20-foot-long and 7-foot-high wall was constructed in front of the Conex container at a distance of 15 feet. Three sides of the Conex container were also confined by the sandbag walls and two layers of sandbags were placed on the top of the container as in Test 7.

The same type and amount of the munitions as in Test 7 was placed in the container. Three pressure transducers were placed at the same location as in Test 7. Twelve mines were placed at the center of the container.

The mines were detonated. Not very many fragments were found beyond 300 feet from the container. A lot of grenades, flares, and other small arms cooked off. It was estimated that about 90 to 95% of the fragments were in a 60-foot radius. A lot of fragments burned for many hours. The pressures of 2.2 psi at 30 feet, 2.5 psi at 60 feet, and 0.9 psi at 75 feet were registered by the transducers.

TESTS AT CHINA LAKE, CALIFORNIA

The Department of Defense Explosives Safety Board requested that we conduct a few tests detonating 75 lbs (inside the Conex) or more bare charge without any kind of sandbag confinement around the Conex container. These tests could not be conducted at Socorro, NM, because of safety and nonavailability of a large, flat area for the collection of debris/fragments after the test. So, an alternate test site was selected to conduct these tests.

A site in excess of 2,500 feet by 2,500 feet was de-bushed on a generally flat lakebed surface at Cactus Flats, China Lake, CA. The radial lines and circular arcs were staked and marked on the ground with chalk. Radial lines were marked every 30 degrees. Circular arcs were chalked at 60 feet, 30-foot intervals from 60 to 300 feet, and 600 feet. Distances from ground zero were marked at 100-foot intervals along each of the radial lines from 600 to 1,200 feet.

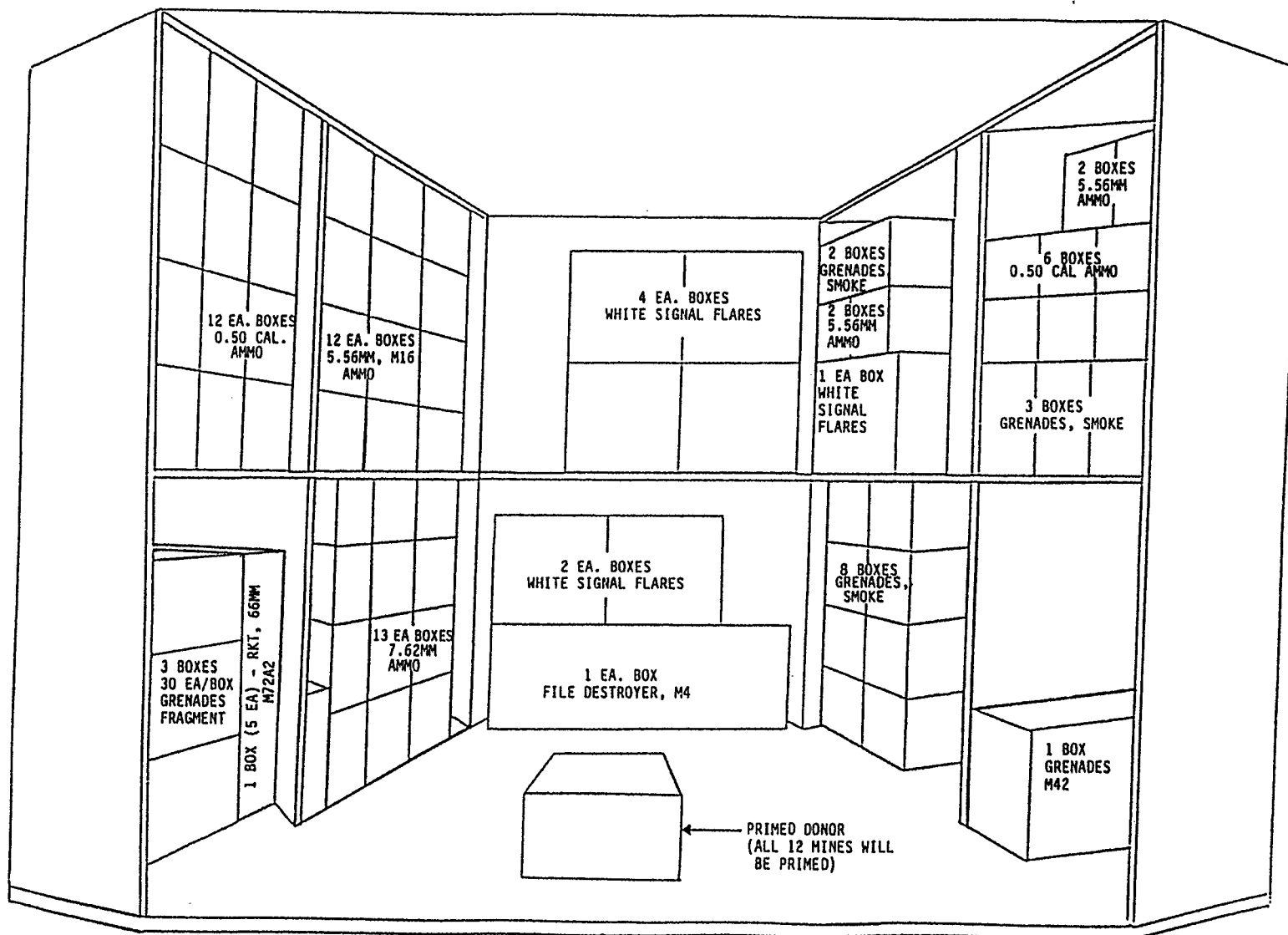


Figure 6. The Ammunition in the Container, Test Nos. 7 and 8.

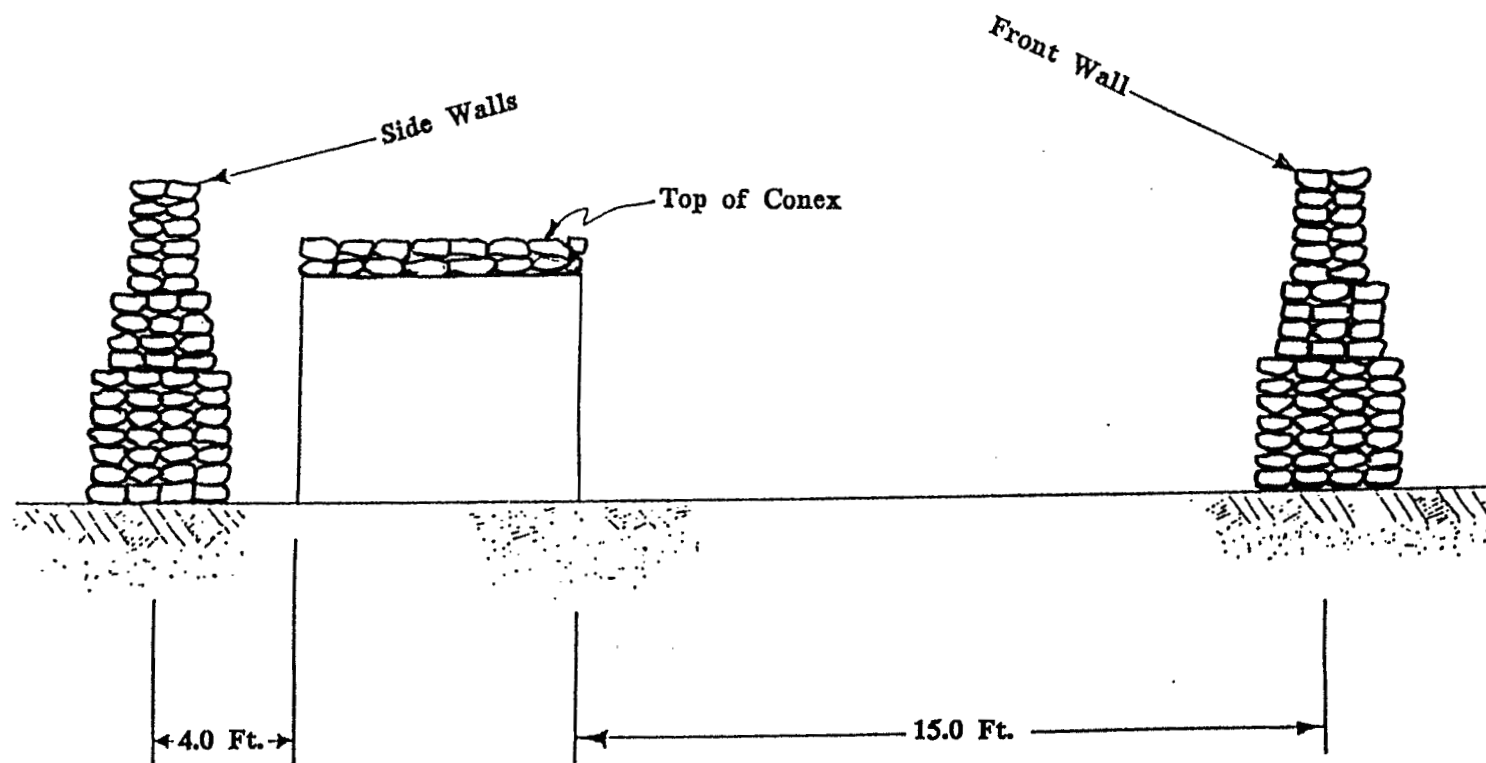


Figure 7. The Sandbag Wall Configuration for Test Nos. 7 and 8.

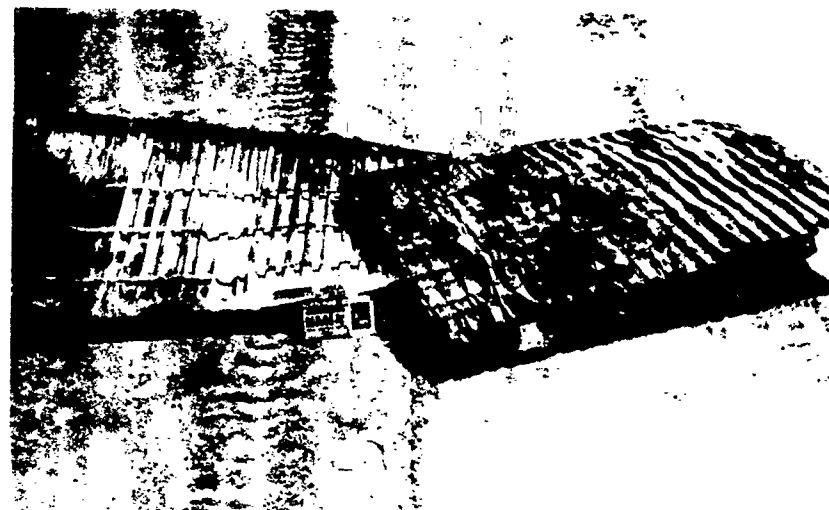


Figure 8.1. (a), (b), (c), and (d) Conex part, Ammo boxes, Mixed munition, and Conex part at Ground zero, Test No. 7.

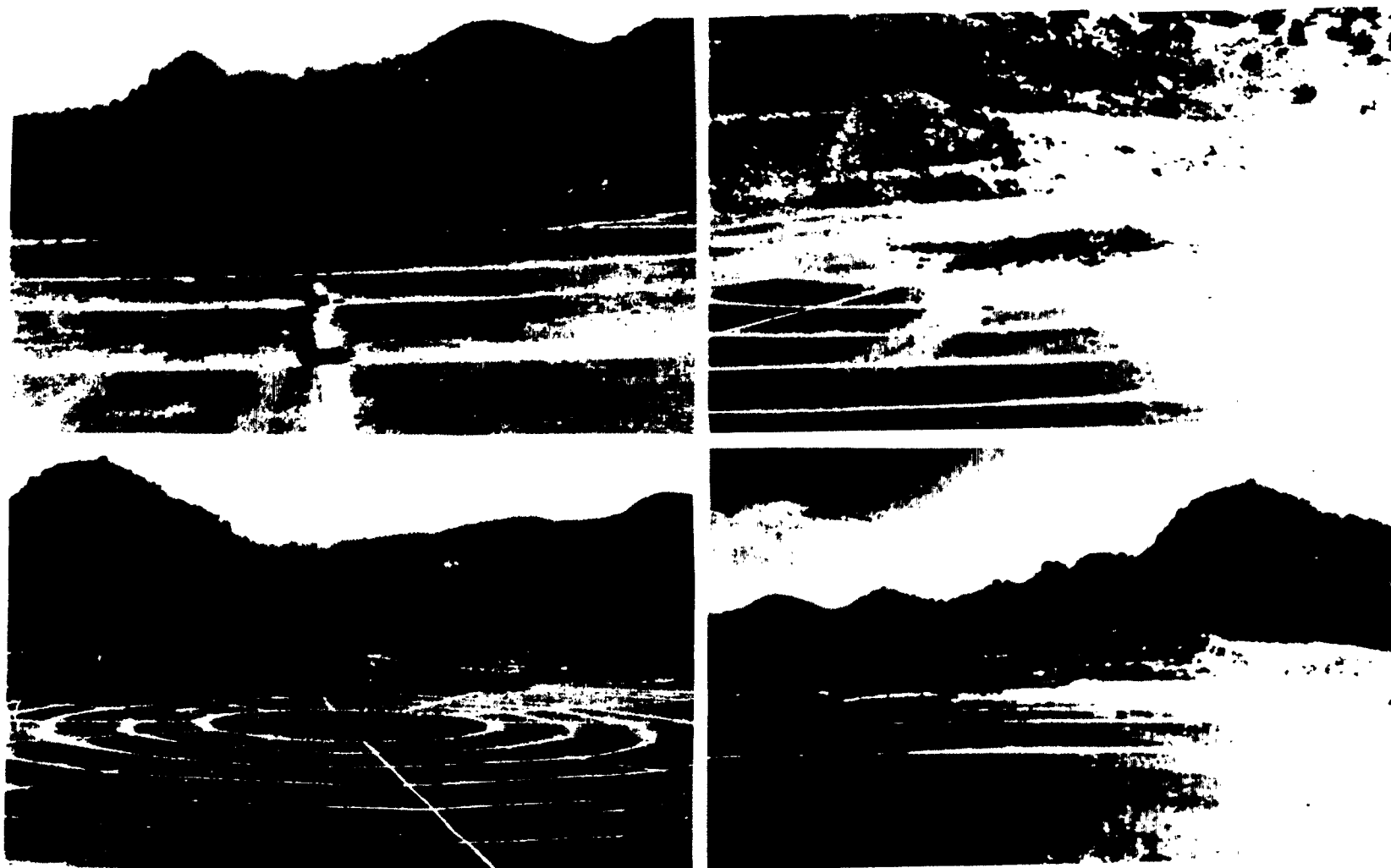


Figure 8.2. (a), (b), (c) and (d) Overall view of the post-test site, Test No. 7.

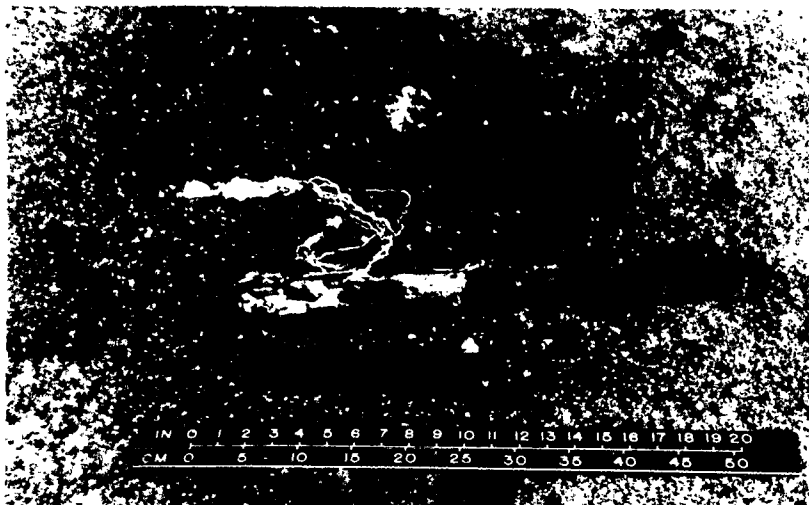


Figure 8.3. Test No. 7. (a) Grnd and Flare between 180 and 210 feet; (b) Grnd and 50 Cal between 210 and 240 feet; (c) and (d) Grnd, Flare and Conex part between 240 and 270 feet.

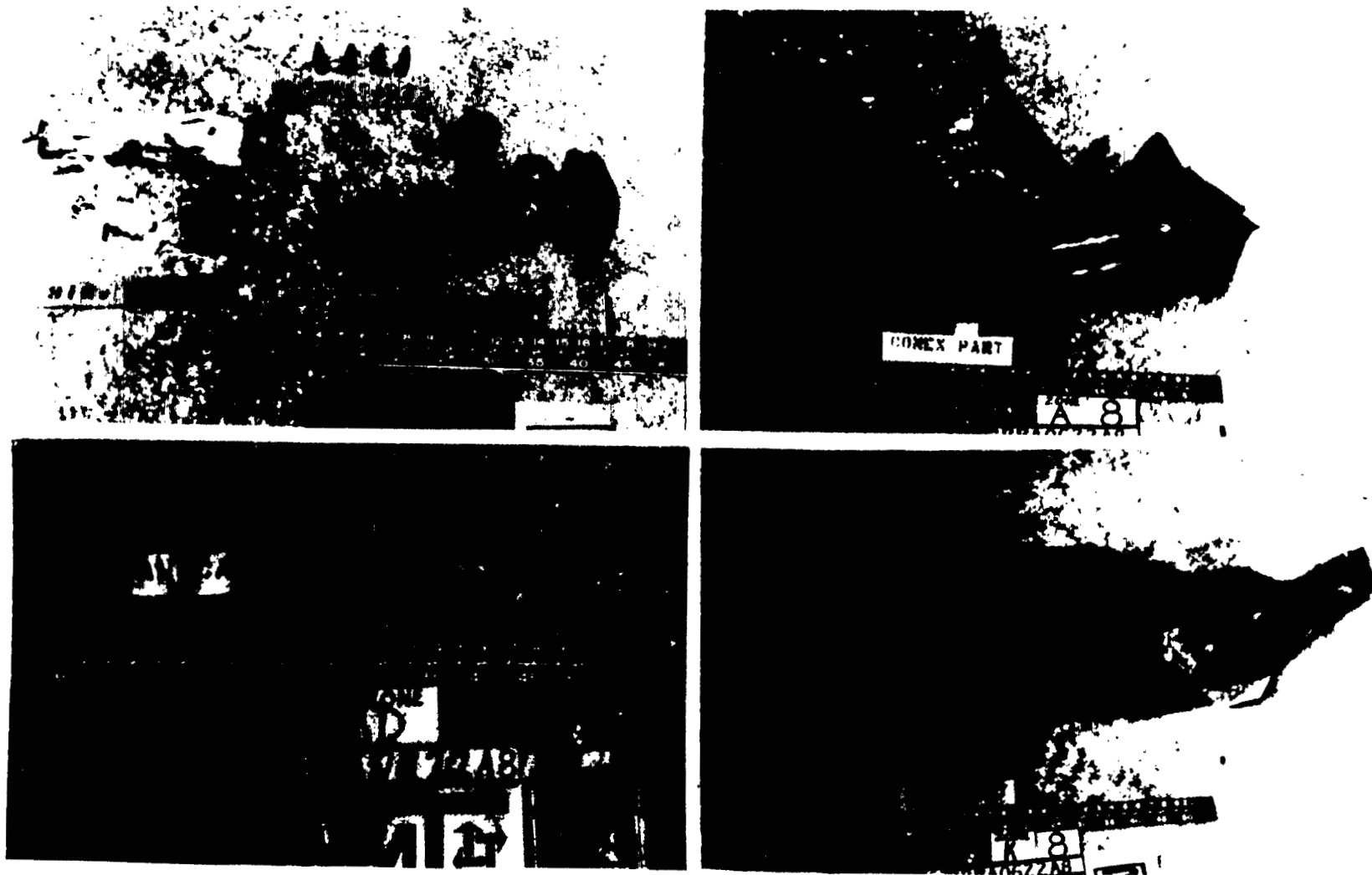


Figure 8.4. Test No. 7. (a) Flare, 50 Cal and Grnd; (b) and (d) Conex parts; (c) 50 Cal between 270 and 300 feet.

TEST NO 9

The same amount of munitions (as in the tests conducted at Socorro, NM) were placed in the container. Three Bikini blast pressure gauges were placed outside of the door of the container at 30, 60, and 90 feet from ground zero. A 75-lb bare charge (70 lbs Comp B and 5 lbs C-4) was placed at the center of the container. The remaining munitions were placed in the container the same way as in other tests. A packing arrangement of the munition in the container is shown in Figure 9.

The charge was initiated using the explosive bridge wire detonator. The Conex container was broken into many fragments. Some of the fragments were thrown to large distances. One fragment was found at a distance of 906 feet, and the second fragment was located at a distance of 824 feet from ground zero. The majority of the munitions and other debris or fragments were found within the 60-foot radius. Many smoke grenades were initiated by the detonation of the bare charge. The M72A2 rockets were broken apart by the detonation but did not appear to have functioned. The mines were expelled and survived with minimal damage. The wooden shelves and other wooden ammunition storage boxes were set afire by the detonation, but the fire lasted for less than one hour. Some of the ammunition cooked off. After-test pictures are shown in Figure 10.

TEST NO 10

Two Conex containers (acceptor and donor) were employed in this test. The same amount of munitions (as in the last test) was placed in the donor container. The acceptor container was placed at a distance of eight feet from the donor container. A few grenades, rockets, mines, and other ammunition were placed in the acceptor container. Again, three Bikini blast pressure gauges were placed at 30, 60, and 90 feet from ground zero. A 500-lb bare charge (495 lbs of Comp B and 5 lbs of C-4) was placed at the center of the acceptor container. Ammunition placement in the containers is shown in Figures 11 and 12.

Again an explosive wire detonator was used to initiate the 500-lb charge. Both containers were destroyed. A shallow crater was formed under the donor container, but no crater was formed under the acceptor container. Fragments of the Conex containers were found at the greatest distances from ground zero. One 6-inch by 14-inch fragment of container was found at 1,156 feet from ground zero. A 1-inch by 3-foot-long rod from the door latch mechanism of the container was found at 1,138 feet. Some of the file destroyer material was burned by the fire, but no ammunition inside the acceptor container detonated.

Ammunition boxes were scattered within the area. Most of the boxes were damaged and broken open. Some of the ammunition cooked off. Four linked 0.50-caliber rounds were located at a distance of 689 feet. One box of 7.62-mm ammunition was found at 1,100 feet. The rockets were broken apart but did not seem to function. The inert mines were expelled and survived with minimum damage. The signal flares and smoke grenades were scattered in different sectors. The majority of the debris and other fragments were found within a 90-foot radius of ground zero. After-test photographs are shown in Figure 13.

OVERALL RESULTS

The locations where the debris/fragments were found varied from test to test. In some tests, the debris/fragments did not go beyond 300 feet from the point of detonation, but in other tests some

TOP	12 Boxes 0.50 Cal 3 Boxes 7.62 Ammo 2 Box 5.56 Ammo	TOP	1 Box (15 ea) RKT-66mm-M72A2
BOTTOM	8 Boxes 0.50 Cal	BOTTOM	20 Boxes Smoke Grenades
COMP B: BARE CHARGE ON THE FLOOR 70 POUNDS C-4 5 POUNDS		BOTTOM	1 Box File Destruct 12 Inert Mines
TOP	8 Boxes 5.56 Ammo	TOP	1 Box Signal Flares 10 Boxes Smoke Grenades 11 Boxes 5.56 Ammo
BOTTOM	12 Boxes 7.62 Ammo	BOTTOM	1 Box Signal Flares 14 Boxes Smoke Grenades

Figure 9. Ammunition in the Container, Test No. 9.



Figure 10.1. Test No. 9. (a) Mixed munition at ground zero;
(b) Grnd, and ammo boxes between 60 and 90 feet.

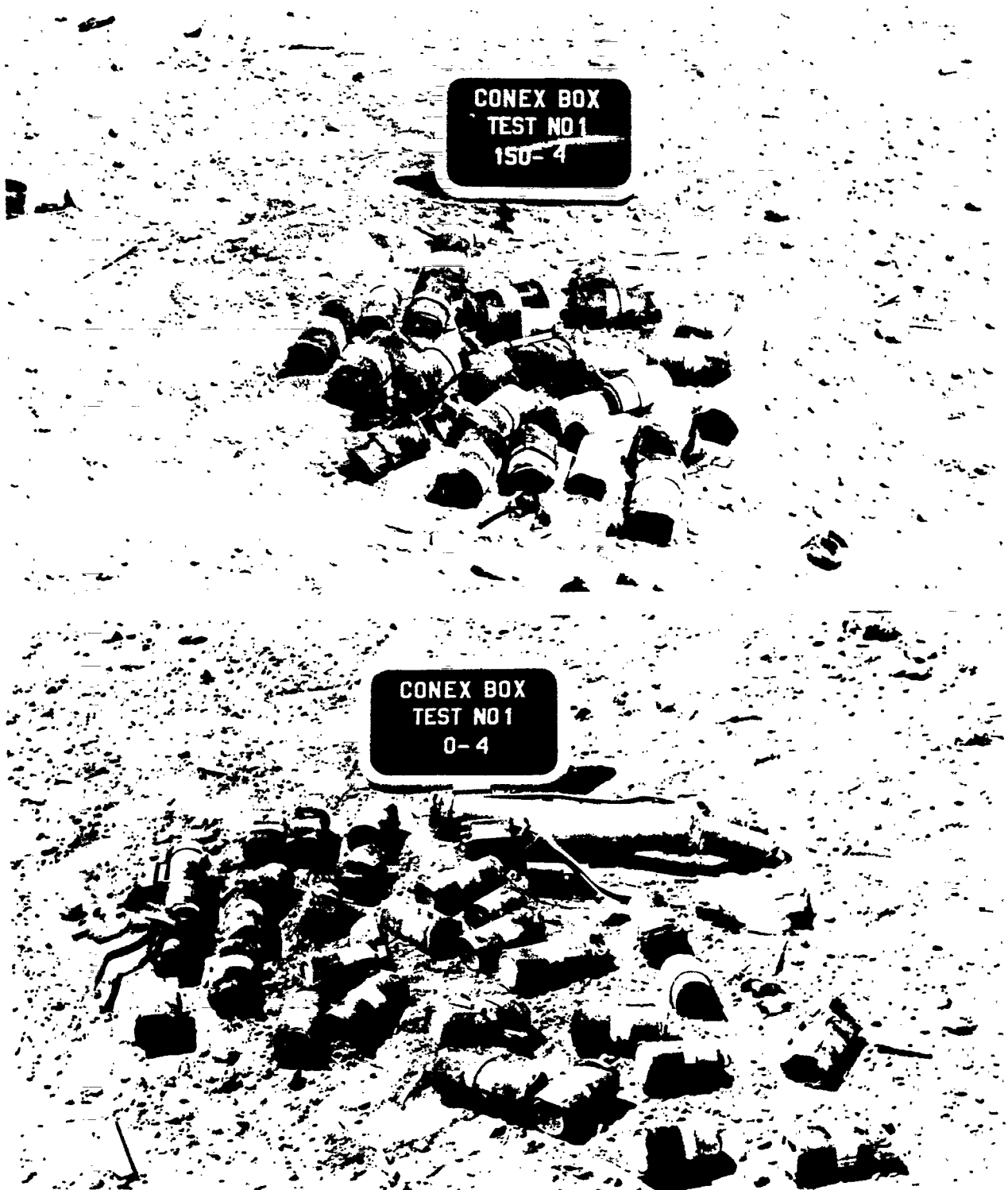


Figure 10.2. Test No. 9. (a) and (b) Grnd and 66mm Rkt between 120 and 150 feet.

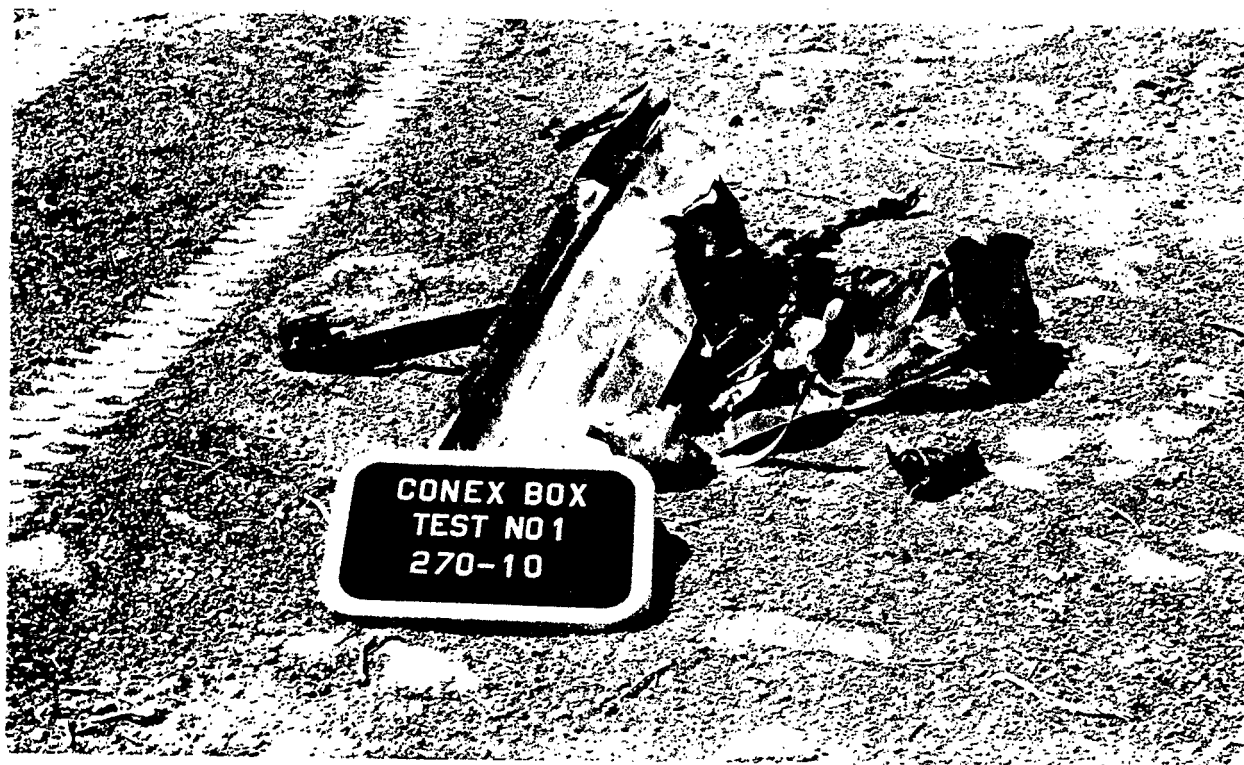


Figure 10.3. Test No. 9. (a) Part of Conex between 300 and 400 feet
(b) Conex part and Grnd between 500 and 600 feet.

TOP	12 Boxes 0.50 Cal 3 Boxes 7.62 Ammo 2 Box 5.56 Ammo	TOP	1 Box (15 ea) RKT-66mm-M72A2
BOTTOM	8 Boxes 0.50 Cal	BOTTOM	20 Boxes Smoke Grenades
COMP B: BARE CHARGE ON THE FLOOR 495 POUNDS C-4 5 POUNDS		BOTTOM	1 Box File Destruct 12 Inert Mines
TOP	8 Boxes 5.56 Ammo	TOP	1 Box Signal Flares 10 Boxes Smoke Grenades 11 Boxes 5.56 Ammo
BOTTOM	12 Boxes 7.62 Ammo	BOTTOM	1 Box Signal Flares 14 Boxes Smoke Grenades

Figure 11. Ammunition in the Donor Container, Test No. 10.

<p>TOP 6 Boxes 7.62 Ammo</p> <p>BOTTOM 5 Boxes 0.50 Cal</p>	<p>TOP</p> <p>1 Box (15 ea) RKT 66-mm M72A2</p> <p>BOTTOM</p> <p>11 Boxes Smoke Grenades</p>
	<p>BOTTOM</p> <p>1 Box File Destruct</p> <p>TOP</p> <p>26 Inert Mines</p>
<p>TOP 5 Boxes 5.56 Ammo</p> <p>BOTTOM 9 Boxes 7.62 Ammo</p>	<p>BOTTOM</p> <p>1 Box Signal Fiars 8 Boxes Smoke Grenades</p>

Figure 12. Ammunition in the Acceptor Container, Test No. 10.



Figure 13.1. Test No. 10. (a) Conex part between 300 and 400 feet;
(b) Conex part between 400 and 500 feet.



Figure 13.2. Test No. 10. (a) Conex part; and (b) small arm between 500 and 600 feet.

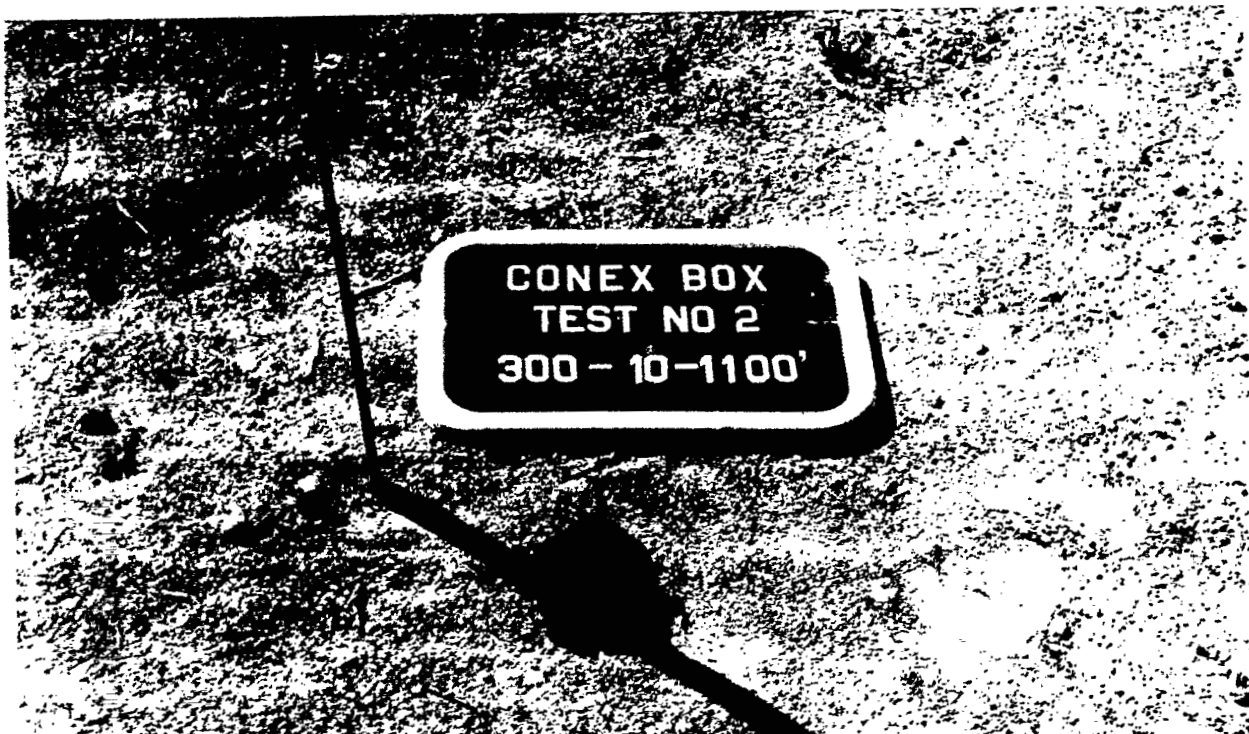
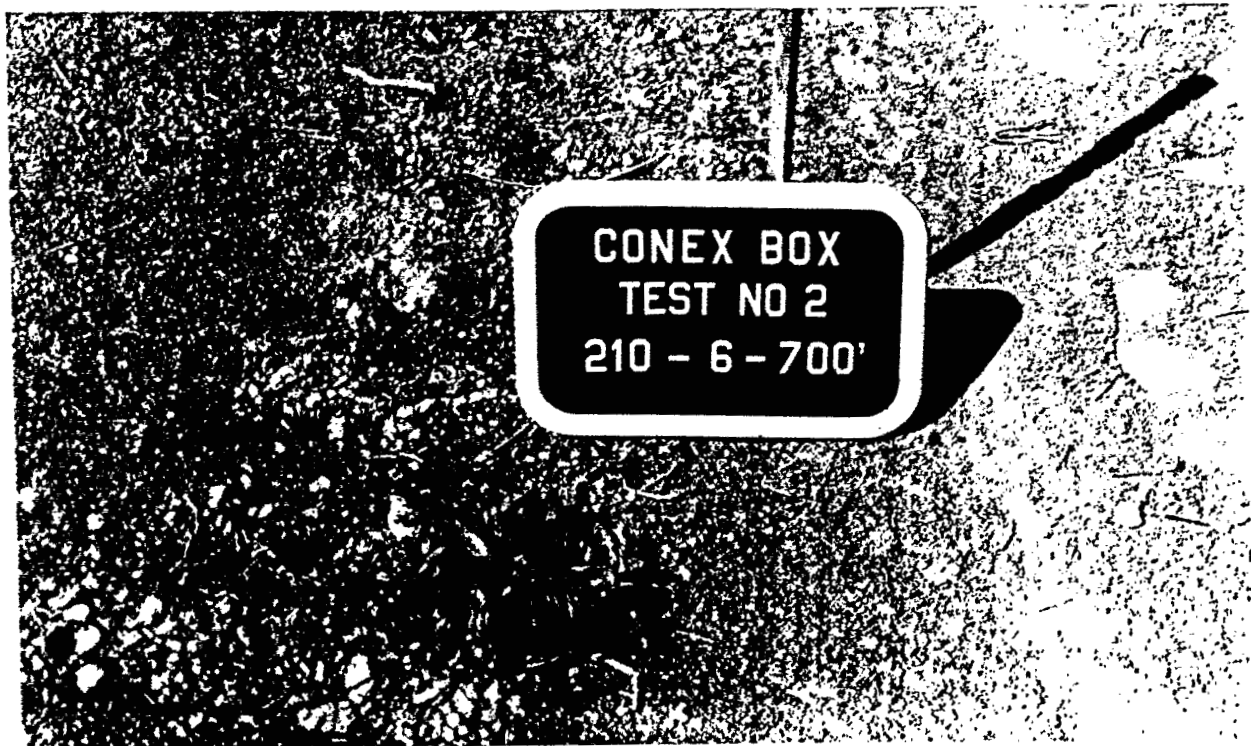


Figure 13.3. Test No. 10. (a) Ammo box at 700 feet; and (b) Part of Grenade at 1100 feet.

debris/fragments were found beyond 600 feet. The kick-out data from the last four tests are given in Tables III - V.

The fragment density at any distance was computed on the basis of a worst-case assumption. It was assumed that any fragment found in a sector at a distance greater than x feet from the origin could hit a standing person in that sector. The fragment density was computed as the number of fragments divided by the vertical area and multiplied by 600. That gave the fragment density per 600 square feet.

The fragment density, at different locations, is calculated by using 30-degree sectors. When the mean density was computed, the sectors in which no fragments were found were excluded. The fragment density and distance were plotted for 25, 75, 160, and 500 lbs of explosive. These plots are shown in Figures 14 and 15. For 500 lbs of explosive, the fragment density of less than one fragment per 600 square feet is at about 800 feet. On the other hand, the fragment density of less than one fragment per 600 feet, for 75 lbs of explosive, is between 700 to 800 feet.

In some tests, the fire started a few minutes after the detonation and lasted for a few minutes, but in other tests the fire started and lasted for some time and restarted and kept on burning for a long time (many hours). In Tests 2 and 3, the fragments and/or debris burned for one to two hours in the space between the containers. In Test 4, the fire lasted for more than two hours. In Tests 5, 7, and 8, the fragments and other munitions burned many hours. No appreciable fire was observed in Test 6. In Tests 9 and 10, the fire lasted for less than one hour.

Several rounds (7.62 mm, 5.56 mm, .50 cal, flares, grenades, etc.) were cooked off as a result of fire or heat. Some of the live munitions were recovered in each test. From the recovered munitions, it was estimated that about 25 to 35 lbs of explosive were consumed during the detonation process in each of the first four tests. It is estimated that all 160 lbs of the explosive was expended in Test 6 because no explosive was recovered in this test.

In Tests 2 and 3, the acceptor Conex was turned/flipped over and caved in, thus sustaining some physical damage. No appreciable damage was done to the contents of the acceptor container. The acceptor Conex did not move or flip over in Tests 4, 5, and 6. Much of the blast was absorbed by the sandbag wall (between the containers), thus preventing the acceptor container from sustaining much damage. The blast inside the donor Conex was so high that it created a two- to three-foot-deep crater underneath the donor Conex.

SUMMARY

A series of tests was conducted to determine the fragments hazard distance when the explosive, inside the donor Conex, is deliberately or accidentally detonated. First, three tests were conducted to determine the external debris and hazard distance and to check whether the detonation of explosives in one container would detonate the explosive in the adjacent container. The next three tests were conducted by sandbagging the containers on three sides. The next two tests were conducted by sandbagging the containers on three sides and sandbagging the walls at the front, 15 feet from the containers. Last, two tests were conducted by detonating 75 and 500 lbs of bare charge in donor containers without sandbags.

A lot of fragments and debris were found beyond 300 feet in Tests 1, 2, 3, 6, 9, and 10. Fewer fragments and other debris were found beyond 300 feet in Tests 4, 5, 7, and 8. Some fragments were

TABLE III
CONEX TEST NO. 7

Zone	A	B	C	D	E	F
9	2-50P	3-FG				
8	10-FG 2-WPFB 4-50P 1-MF			2-50P 2-50C		
7	1-MF 4-FG 1-WPFB			2-50P 1-50C 1-M42	3-50P	
6	5-FG 12-50P 5-50C		4-50P	1-50C	7-50P 1-50C	
5	1-FG 1-WPFB	4-50C 1-556P 4-50P	3-50C 4-50P	3-50C 1-50P	3-50C	5-50P 1-50C 2-WPFB
4	1-FG 7-50P,C 2-MF 1-WPF	2-50C 3-50P 1-762C	3-50P 1-762C	3-50C 4-50P	3-50P 1-50C	1-50C 2-50P
3	6-FG 8-50C 3-50P	1-762C 4-50C 4-50P	13-50C 1-50P 1-762C	5-50C 2-50P	5-50C 2-50P	4-50C 1-WPF
2	4-FG 9-50P,C 2-762P	13-50P,C 1-WPFB 1-762P	5-50C 2-762C 7-50P	8-50C 3-50P 1-WPF	3-50C 5-50P 1-WPFB	6-50C 1-50P
1	5-FG 6-50P,C 1-762P	19-50P,C 2-762P,C 1-FG	11-50C 5-50P 1-WPFB	5-50C 6-50P	5-50C 3-50P	1-556C 3-50C 2-50P
0	8 BOXES-50, 439-50, 20 BOXES-5.56, 41 BOXES-7.62, 47-SG, 3-M42, 41-FG, 154-WPF, 2-66 W/H, 4-66 MTR					

TABLE III (continued)

CONEX TEST NO. 7

ZONE	G	H	I	J	K	L
9					1-FG	
8				2-50P	8-50P 1-MF	
7				1-50P 1-50C	1-FG 1-50P	
6	1-WF			2-MF 2-50P 1-762P	1-WPF 2-50P 2-MF	9-50P,C 5-762P,C 1-WPF
5	2-WPF			3-50C 1-WPF	4-50C 2-50P 1-762C	2-50C 3-50P 1-WPFB
4	3-50C 1-WPF		5-50P,C 1-M42 1-WPF 2-MF	2-50C 1-MF	2-50P 1-762C 2-762P 4-50C	1-50C 1-50P 1-MF
3	3-50C 1-WPF	1-WPF 2-50C	4-50P,C 5-WPF 1-556C	6-50P,C 4-762P,C 1-WPF	5-50C 1-762P 3-50P	3-5-P,C 1-762P 1-762C
2	1-50P 1-WPFB	4-50C 2-WPFB 8-WPF	6-50P,C 4-WPFB	1-50P 1-50C 1-WPF	4-50P,C 1-762C 1-M42	13-50P,C 3-WPFB 1-M42
1	6-50C 4-50P	3-WPFB 4-50C 3-50P	1-50C 1-WPF	5-50P,C 1-WPF 1-M42	17-50P,C 4-762P,C 2-WPF	12-50P,C 2-762P,C 2-WPF
0	3 BOXES-7.62B, 2 BOXES-5.56B, 5 BOXES-50B, 75-SG/SGB 1-FG, 38-M42, 32-WPFB/WPF					

TABLE IV
CONEX TEST NO. 9

ITEM NO	BEARING DEG/MIN/SEC	DISTANCE FEET (M)	DESCRIPTION/SIZE
1	351/37/03	530.6 (161.7)	BUILDING FRAGMENT - 4' BY 5'
2	349/50/25	636.6 (194.0)	BUILDING FRAGMENT - 1' BY 7'
3	351/14/33	663.8 (202.3)	SMOKE GRENADE
4	358/44/50	663.3 (202.2)	SMOKE GRENADE
5	0/25/46	657.7 (200.5)	SMOKE GRENADE
6	1/3/16	625 (190.5)	BUILDING FRAGMENT - 8" BY 8"
7	1/11/09	698.2 (212.8)	SMOKE GRENADE
8	5/52/06	689.6 (210.2)	SMOKE GRENADE
9	7/54/26	701.3 (213.8)	SMOKE GRENADE
10	8/25/05	618.5 (188.5)	SMOKE GRENADE
11	83/31/34	625.4 (625.4)	CHAIN LINK DIVIDER MATERIAL FOR FILE DESTRUCT
12	163/20/55	605.7 (184.6)	SMOKE GRENADE
13	185/10/21	619.8 (188.9)	SMOKE GRENADE
14	183/34/58	604.7 (184.3)	SMOKE GRENADE
15	265/30/20	739 (225.2)	BUILDING FRAGMENT - 2' BY 2.5'
16	273/27/55	637.5 (194.3)	BUILDING FRAGMENT - 5" BY 8"
17	278/03/45	623.5 (190.0)	BUILDING FRAGMENT - 3" BY 3"
18	277/33/47	678.3 (206.8)	BLDG FRAG - 6" BY 18" AND DOOR HANDLE 18" APART
19	272/36/02	650 (198.1)	HASP FROM DOOR LATCH
20	272/07/32	767.8 (234.0)	DOOR LATCH ROD - 1" BY 2"
21	272/57/59	784.8 (239.2)	BUILDING FRAGMENT - 2" BY 2"
22	278/21/57	823.9 (251.1)	BUILDING FRAGMENT - 4" BY 18"
23	284/18/09	775.7 (236.4)	BUILDING FRAGMENT - 6" BY 3"
24	286/37/49	652.8 (199.0)	BUILDING FRAGMENT - 2" BY 3"
25	296/13/05	905.8 (276.1)	SECTION OF DOOR LATCH MECHANISM
26	304/52/52	605.8 (184.6)	BUILDING FRAGMENT - 1.5" BY 6"
27	328/54/41	603.4 (183.9)	BUILDING FRAGMENT - 2" BY 3"
28	343/14/34	632 (192.6)	SMOKE GRENADES (2) - 5' APART ON ROADWAY
29	341/44/48	631.2 (192.4)	SMOKE GRENADE - ON ROAD
30	345/00/48	608.4 (185.4)	SMOKE GRENADE
31	336/05/31	340.7 (103.8)	BUILDING FRAGMENT - 1.5" BY 2.5', SM BLDG FRAG SHARDS
32	335/04/16	446.2 (136.0)	BUILDING FRAGMENT - 8" BY 1'
33	352/58/38	370 (112.8)	BUILDING FRAGMENT - 3" BY 2'
34	352/29/44	442.2 (134.8)	BLDG FRAGS (3) - 2 @ 2" BY 7', 1 @ 6" BY 8"
35	9/10/46	372.7 (113.6)	BUILDING FRAGMENT - 3" BY 5'
36	1/42/29	295.2 (90.0)	BUILDING FRAGMENT - 2.5" BY 4'
37	33/21/55	346.5 (105.6)	BUILDING FRAGMENT - 2" BY 2'
38	39/21/55	311.2 (94.9)	BUILDING FRAGMENT - 1" BY 5'
39	37/30/22	296.5 (90.4)	BUILDING FRAGMENT - 1" BY 2' (JUST INSIDE 300' ARC)
40	44/30/47	293.5 (89.5)	BUILDING FRAGMENT - 1" BY 2' (JUST INSIDE 300' ARC)
41	54/46/11	360 (109.7)	BUILDING FRAGMENT - 2" BY 2'
42	71/27/15	315.8 (96.3)	BUILDING FRAGMENT - 2" BY 7'
43	86/41/34	323.4 (98.6)	BLDG FRAGS (3) - 6" BY 18", 2" BY 5.5", 1" BY 6"
45	75/31/41	568.1 (173.2)	CHAIN LINK DIVIDER MATL, BLDG FRAG @ 4" BY 1'
46	142/58/10	417.8 (127.3)	SMOKE GRENADE
47	159/14/01	448.5 (136.7)	BUILDING FRAGMENT - 1" BY 6"
48	166/40/08	378.5 (115.4)	BUILDING FRAGMENT - 2" BY 2.5'
49	172/34/11	342.7 (104.5)	BUILDING FRAGMENT - TWISTED - 8" BY 8"
50	190/35/25	313.9 (95.7)	BLDG FRAG - 1" BY 6", 2 BOXES 7.62 AMMO
51	241/14/08	463.3 (141.2)	BLDG FRAGS - 1 @ 2" BY 4', MANY SMALL FRAGMENTS
52	255/16/18	427 (130.1)	BUILDING FRAGMENT - 3" BY 5.5', PART OF DOOR LATCH
53	256/36/33	566 (172.5)	BUILDING FRAGMENT - 3" BY 3"
54	275/29/31	546.1 (166.5)	BLDG FRAGS (4) - AVERAGE 4" BY 4"
55	283/57/50	360.8 (110.0)	DOOR FRAME - 1.5" BY 6" WITH SECTION OF WALL

TABLE V

CONEX TEST NO. 10

ITEM NO.	BEARING	DISTANCE	DESCRIPTION / SIZE
	DEG-MIN-SEC	FEET (M)	
1	97/12/33	625.7 (190.7)	BUILDING FRAGMENT - 1' BY 8'
2	346/28/42	658.6 (200.7)	BOX 50 CAL AMMO - BROKEN, SCATTERED
3	350/04/27	748.3 (228.1)	BUILDING FRAGMENT - TWISTED - 2' BY 3.5'
4	348/45/33	798.2 (243.3)	BUILDING FRAGMENT - STRIP - 1.5' BY 8'
5	335/04/38	687.4 (209.5)	BUILDING FRAGMENT - 13" BY 27"
6	332/12/50	1043.9 (318.2)	BUILDING FRAGMENT - TWISTED - 6" BY 12"
7	319/37/49	940.3 (286.6)	BUILDING FRAGMENT - 2.5' BY 2.5'
8	328/10/37	696.4 (212.3)	BUILDING FRAGMENT - 2" BY 3'
9	326/35/26	622.6 (189.8)	BUILDING FRAGMENT - STRIP - 1.5" BY 3"
10	316/41/38	783.8 (238.9)	BUILDING FRAGMENT - 1' BY 1'
11	299/41/23	599.2 (182.6)	DOOR FRAME WITH HINGE (GREEN-COLORED DONOR)
12	294/15/39	617.1 (188.1)	BUILDING FRAGMENT - TWISTED - 2' BY 3'
13	297/18/37	723.0 (220.4)	BUILDING FRAGMENT - 4" BY 8"
14	291/32/39	786.4 (239.7)	BUILDING FRAGMENT - 3" BY 18"
15	298/22/50	869.6 (265.1)	BUILDING FRAGMENT - 1.5' BY 2'
16	286/45/43	919.8 (280.4)	BUILDING FRAGMENT - 1' BY 16"
17	278/01/32	623.8 (190.1)	BUILDING FRAG - 4" BY 3' / DOOR LATCH ROD 1" BY 3'
18	281/32/02	661.7 (201.7)	BUILDING FRAGMENT - 6" BY 6"
19	277/31/17	679.8 (207.2)	BUILDING FRAG - 6" BY 1.5' / DOOR HANDLE (GREEN)
20	280/26/43	746.6 (227.6)	BUILDING FRAGMENT - 3" BY 2'
21	281/55/24	815.6 (248.6)	BUILDING FRAGMENT - 4" BY 6"
22	275/44/54	827 (252.1)	BUILDING FRAGMENT - 6" BY 1.5'
23	274/04/18	751.7 (229.1)	BUILDING FRAGMENT - 8" BY 1'
24	269/26/26	695.4 (212.0)	BUILDING FRAGMENT - 3" BY 8"
25	268/50/32	675.5 (205.9)	BUILDING FRAGMENT - 4" BY 6"
26	265/29/24	738.4 (225.1)	BLDG FRAGS (2) 1- 3" BY 3.5'; 1 - 2" BY 6"
27	261/30/42	763.3 (232.7)	BUILDING FRAGMENT - 3" BY 3"
28	272/37/24	649.5 (198.0)	CLUSTER 3 SMALL BLDG FRAGS AND NWC LOCK HASP
29	272/58/16	1138.3 (347.0)	DOOR LATCH ROD - 1" BY 3'
30	259/15/33	940.9 (286.8)	BUILDING FRAGMENT - TWISTED - 8" BY 1'
31	244/38/52	692.7 (211.1)	BUILDING FRAGMENT - 1' BY 2'
32	234/43/12	604.2 (184.2)	DOOR HINGE
33	243/20/57	1155.7 (352.3)	BUILDING FRAGMENT - TWISTED - 6" BY 14"
34	232/48/10	688.6 (209.9)	FOUR LINKED 50 CAL ROUNDS
35	225/19/46	589.5 (179.7)	DOOR FRAME (GREEN)
36	225/20/12	676.9 (206.3)	1 BOX 7.62 AMMUNITION
37	223/02/38	665.9 (203.0)	9 ROUNDS 7.62 AMMUNITION
38	215/25/44	612.9 (186.8)	1 BOX 7.62 AMMO AND SCATTERED ROUNDS
39	214/34/48	707.9 (215.8)	BUILDING FRAGMENT - 8" BY 1'
40	212/17/43	764.3 (233.0)	1 BOX 7.62 AMMUNITION
41	218/37/39	754.5 (230.0)	1 BOX 7.62 AMMUNITION
42	225/54/56	1120.5 (341.5)	BUILDING FRAGMENT - 1.5" BY 1'
43	214/52/33	930 (283.5)	1 BOX 7.62 AMMUNITION
44	203/32/52	675.4 (206.0)	BUILDING FRAGMENT - TWISTED - 1' BY 2'
45	204/00/54	722.6 (220.4)	BUILDING FRAGMENT - TWISTED - 8" BY 8"
46	209/59/37	1100 (335.3)	1 BOX 7.62 AMMO - 6" FROM 1100' HUB ON 210 DEG RADIAL
47	180/07/08	900 (374.3)	1 SMOKE GRENADE AND 2 FLARES
48	162/56/14	735.8 (224.3)	BUILDING FRAGMENT - 8" BY 2'
49	166/42/52	693.6 (211.4)	BUILDING FRAGMENT - 2" BY 5'
50	169/39/52	678.8 (206.9)	BUILDING FRAGMENT - 6" BY 6"
51	156/12/44	733.1 (223.4)	BUILDING FRAGMENT - TWISTED - 8" BY 1.5'
52	131/07/45	663.7 (202.3)	BUILDING FRAGMENT - 4" BY 8"
53	120/38/35	602.1 (183.5)	BUILDING FRAGMENT - 6" BY 8"
54	115/23/11	619.9 (188.9)	BUILDING FRAGMENT - 8" BY 5'

TABLE V (continued)

CONEX TEST NO. 10

ITEM NO.	BEARING DEG-MIN-SEC	DISTANCE FEET (M)	DESCRIPTION / SIZE
55	99/57/39	668 (203.6)	BUILDING FRAGMENT - 3" BY 1'
56	85/05/26	836 (254.8)	BUILDING FRAGMENT - 15" BY 18"
57	88/27/25	727.3 (221.7)	BUILDING FRAGMENT - 3" BY 1'
58	88/43/20	619.4 (188.8)	BUILDING FRAGMENT - 3" BY 1'
59	83/35/41	626.4 (190.9)	CHAIN LINK DIVIDER MATERIAL FOR FILE DESTRUCT
60	83/16/56	653.8 (199.3)	BUILDING FRAGMENT - 4" BY 1'
61	81/14/27	667.4 (203.4)	BUILDING FRAGMENT - 4" BY 18"
62	82/10/15	698 (212.8)	BUILDING FRAGMENT - 3" BY 18"
63	81/15/13	838.8 (255.7)	BUILDING FRAGMENT - 2" BY 15"
64	70/25/24	701.6 (213.9)	CHAIN LINK DIVIDER MATERIAL FOR FILE DESTRUCT
65	45/55/39	726 (221.3)	BUILDING FRAGMENT - 3" BY 1'
66	29/10/51	723.5 (220.5)	BUILDING FRAGMENT - 9" BY 1'
67	12/2/11	927.6 (282.7)	BUILDING FRAGMENT - 1' BY 3'
68	10/26/34	739.1 (225.3)	BUILDING FRAGMENT - 1' BY 2'
69	9/48/21	606.4 (184.8)	1 BOX 50 CALIBER AMMUNITION
70	6/51/50	605.7 (184.6)	BUILDING FRAGMENT - 6" BY 1'
71	12/2/11	927.6 (282.7)	REPEAT OF #67
72	3/55/51	1084 (330.4)	BUILDING FRAGMENT - 9" BY 9"
73	0/57/29	646.4 (197.0)	DOOR HINGE
74	359/46/47	695.6 (212.0)	1 BOX 50 CALIBER AMMO, BROKEN OPEN
75	351/25/49	558.1 (170.1)	BUILDING FRAGMENT - 1' BY 2'
76	346/19/51	460.9 (140.5)	BUILDING FRAGMENT - 2' BY 3'
77	291/26/19	532 (162.2)	BUILDING FRAGMENT - 2' BY 2'
78	263/44/11	320.7 (97.7)	BUILDING FRAGMENT - 6" BY 18"
79	269/35/41	304.1 (92.7)	1 BOX 7.62 AMMUNITION
80	250/09/41	433.7 (132.2)	BLDG FRAGS (2) - 1-6" BY 6"; 1-2" BY 4'
81	237/25/25	551.5 (168.1)	ACCEPTOR DOOR (WHITE)
82	231/36/08	527 (160.6)	ACCEPTOR DOOR (WHITE)
83	228/26/17	523.2 (159.5)	ACCEPTOR DOOR LATCH MECHANISM
84	224/53/43	436.7 (133.1)	ACCEPTOR DOOR FRAME
85	224/22/32	343.4 (104.7)	BUILDING FRAGMENT - 6" BY 6"
86	225/24/56	302.4 (92.9)	2 BOXES 7.62 AMMUNITION
87	186/07/54	389.1 (118.6)	ACCEPTOR WALL SECTION - 6" BY 6"
88	186/04/49	451.7 (137.7)	ACCEPTOR WALL SECTION - TWISTED - 3" BY 6"
89	195/27/46	425.3 (129.6)	BUILDING FRAGMENT - 2" BY 3"
90	195/36/00	318 (96.9)	ACCEPTOR DOOR FRAME WITH HINGES 1' BY 6"
91	186/42/49	355.6 (108.4)	ACCEPTOR DOOR FRAME - 1' BY 6"
92	181/55/41	358.5 (109.3)	1 BOX 5.56 AMMUNITION
93	160/59/12	457.3 (139.4)	BUILDING FRAGMENT - 1' BY 8"
94	152/47/22	465.7 (141.9)	BUILDING FRAGMENT 2' BY 4'
95	145/47/22	449.9 (137.1)	BUILDING FRAGMENT - 1.5' BY 3'
96	115/09/10	425.5 (129.7)	ACCEPTOR SIDE WALL - 6" BY 8"
97	48/06/30	597.5 (182.1)	BUILDING FRAGMENT - TWISTED - 1.5' BY 6"
98	50/23/17	474.5 (144.6)	ROCKET - BROKEN
99	40/42/09	480.2 (146.4)	2 ROCKETS (BROKEN), 1 SMOKE GRENADE WITHIN 15' RADIUS
100	22/18/09	345.8 (105.4)	1 ROCKET, BROKEN
101	5/48/18	346.1 (105.5)	1 BOX 7.62 AMMUNITION
102	346/26/02	309.2 (94.2)	1 BOX 5.56 AMMUNITION
103	246/57/10	258.8 (78.9)	BLDG FRAGS (2) - 1 - 2' BY 6"; 1 - 6" BY 5'
104	243/45/00	158.8 (48.4)	BUILDING FRAGMENT - 2' BY 6"
105	284/19/12	163.8 (49.9)	BUILDING FRAGMENT - 3' BY 6"
106	201/48/19	135.9 (41.4)	BUILDING FRAGMENT - 3' BY 6"
107	184/04/33	66 (20.1)	ACCEPTOR FLOOR AND SECTION OF WALL (WHITE)
108	201/01/31	291.2 (88.8)	BUILDING FRAGMENT - 3' BY 4'
109	121/03/01	274.3 (83.6)	BUILDING FRAGMENT - 1' BY 6"
110	49/41/11	58 (17.7)	BUILDING FRAGMENT - 1' BY 6"

1483

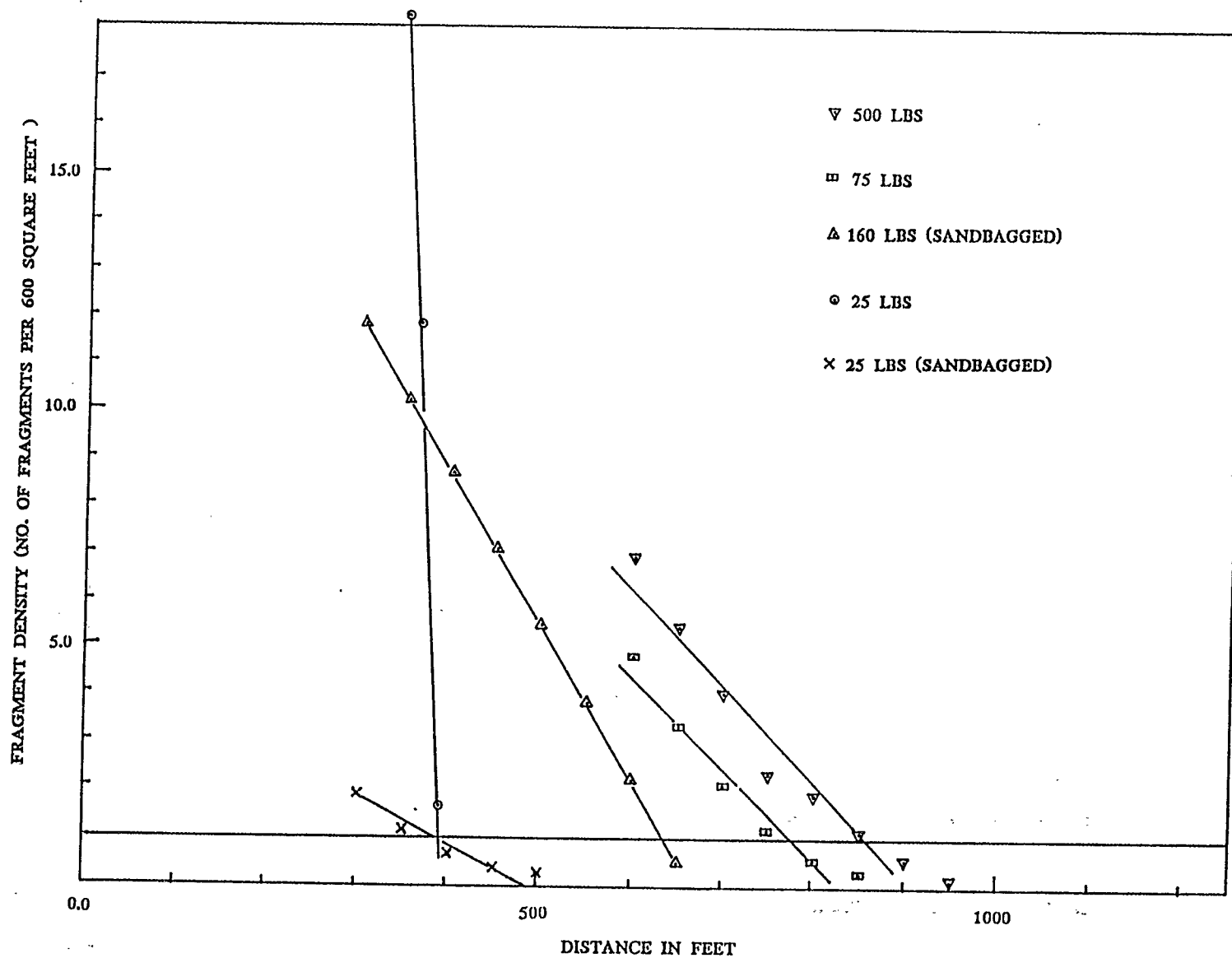


Figure 14. Fragment Density and Distance Plot.

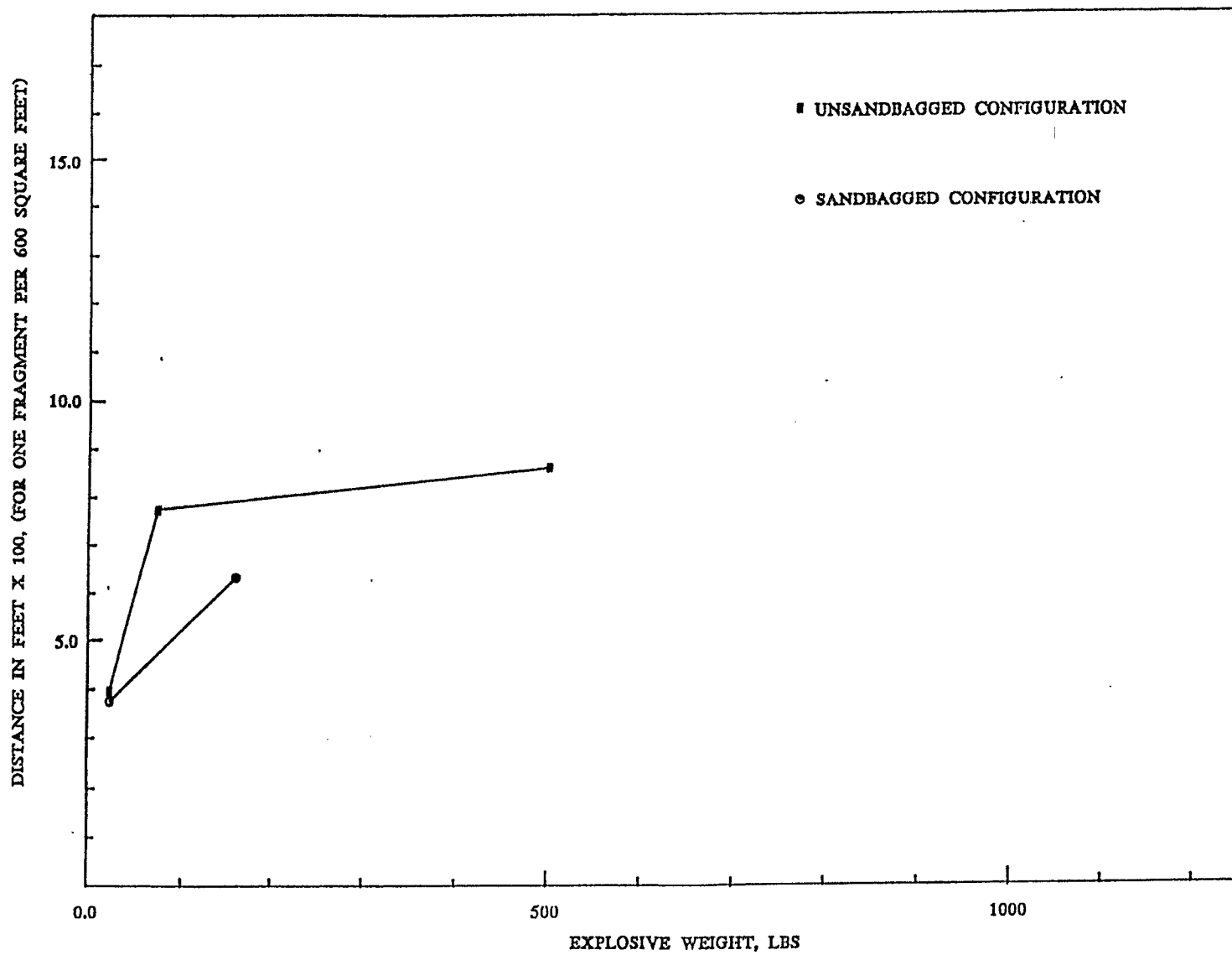


Figure 15. Distance and Explosive Weight Plot.

found beyond 600 feet in Tests 6, 9, and 10. A few metal fragments were also found between 900 and 1,155 feet in Tests 9 and 10.

Detonation did not propagate to the adjacent container in any test even when the distance between the containers was decreased to eight feet. An eight-foot separation distance was selected because at overseas bases the containers were separated by a distance of greater than six feet.

Ammunition cook-off occurred in all the tests. Sandbagging the containers decreased the fragment density at larger distances, but it increased the cook-off and burning rate of the munitions and other debris near the location of the test. So, the probability of cook-off or burning of the munitions and other fragments/debris is greater when the containers are sandbagged.

REFERENCES

1. DoD 6055.9 STD, DoD Ammunition and Explosive Safety Standards, July 1984.
2. AR 385-64, Ammunition and Explosive Safety Standards.
3. William Lawrence, "STORAGE OF MIXED MUNITIONS IN THE CONEX CONTAINERS," TWENTY-THIRD DOD EXPLOSIVE SAFETY SEMINAR, Atlanta, GA, August 1988.

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